109,021

PATENT SPECIFICATION

Convention Date (United States), Oct. 6, 1916.

Application Date (in the United Kingdom), Apr. 26, 1917. No. 6850/17.

Complete Accepted, Aug. 30, 1917.

COMPLETE SPECIFICATION.

Improvements in or relating to Gear Wheels.

We, JAMES EMMET GLEASON and ARTHUR LAWRENCE STEWART, Mechanical Engineers, both of 1000, University Avenue, Rochester, New York, United States of America, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The invention has to do with improvements in gears, with more particular reference to bevel gears, although equally applicable to other types, such as spur gears. The purpose of the invention is to afford a gear of a form that can be readily, economically and commercially cut, and is characterized by theoretically correct profiles of involute formation, and by a continuous curvature from end to end that insures continuous or overlapping engagement between the teeth with a resultant high degree of efficiency. To these and other ends the invention consists in certain improvements and combinations of parts, all as will be hereinafter more fully described, the novel features being pointed out in the claims at the end of the specification.

In the drawings:

Figure 1 is a side view of a gear and pinion constructed in accordance with the invention, looking toward the pinion and to one side of the gear axis;

Figure 2 is a partial plan view of the gear;

Figure 3 is a diagrammatic view illustrating the relative position of the tool head and blank when cutting a bevel gear;

Figure 4 is a similar view showing the arrangement of tool and blank when cutting a bevel pinion;

Figure 5 is a partial elevation of a tool head, showing the position of the cutting tools thereon;

Figure 6 is a similar view of a modified form of tool head for cutting simultaneously on both sides of a tooth space while the cutter travels through;

Figure 7 is a detail view showing in side elevation the cutting relation of the tools with a blank, according to the arrangement shown in Figure 6, and

Figure 8 is a diagrammatic view illustrating in section the operating position of the cutting tools, as shown in Figure 6, with relation to the blank.

Similar reference characters in the several figures indicate the same parts.

For the purpose of giving a full understanding of the present gear, there is described in a general way its method of production according to a practical embodiment of a mechanism adapted for this purpose.

The gear is preferably, although not necessarily, cut by employing a rotary tool head, on which are mounted a series of tools or cutters arranged in spaced relation to each other concentrically of the head, and so disposed that when

the tool head is continuously rotated in engagement with a continuously rotating blank, the cutters successively engage different portions of the blank, each operating to make a single cut on the side of a tooth until all the teeth are completed. This result may be had by arranging the tools at regular intervals so that they engage corresponding sides of every other tooth, or by having the tools arranged in pairs to engage the adjacent sides of adjacent teeth, and cutting both sides of a tooth space at once. According to the first mentioned arrangement, two revolutions of the blank are required in making a single cut on one side of each tooth, while with the latter arrangement, one revolution of the blank results in a single cut on both sides of each tooth. In addition to the indexing movement, which has just been described, the blank is so moved with relation to the cutter, or *vice versa*, as to impart a relative rolling or generating movement to the tooth, in order to generate theoretically correct profiles, and this is preferably accomplished by rolling both the tool head and the blank by means of interconnecting gearing. The rolling motion of the tool head is added to or subtracted from the indexing movement of the blank by differential gearing according to whether the direction of roll is the same, or contrary to the indexing movement of the blank. The terms "generating motion" and "rolling motion" are used synonymously throughout the present description, and refer to the relative movement between the blank and tool that produces a generated tooth, or an involute side face on the tooth. This movement corresponds to the motion of a gear rolling upon a rack or toothed segment, and results in forming a theoretically correct profile on a tooth, or a profile according to a true involute. The term "indexing motion" refers to the movement of the blank for bringing different teeth successively into position for the cutting operation, and the gear of this application is formed by a continuous indexing movement in one direction. In describing the teeth as "curved", reference is made to the shape or curvature from end to end produced by the indexing motion of the blank and the rotary motion of the cutter, and entirely irrespective of the generating movement already discussed. The curve of the resultant tooth is that of a roulette, owing to the rotative movements of both the blank and cutter, which latter has a uniform movement in a curved path across the face of the gear, that is also simultaneously rotated. In Figures 3, 4 and 5, are shown the forms of cutter heads employed in cutting a gear and pinion respectively, the alternate tools having their cutting edges extending in opposite directions, causing every other tool to operate, for each setting of the blank, while the remaining tools are idle. Thus, with the arrangement of Figure 3, the tools indicated by x make a cut each time they pass through the blank, while those marked y move through the blank without cutting. After the teeth are completed on one side, the blank is reset or readjusted to permit the tools y to operate on the opposite sides of the teeth, and during this operation the tools x are idle. Figure 4 shows a reverse arrangement for cutting a pinion. In Figure 6, the tools are arranged in pairs which pass through the tooth spaces successively, each pair operating on the adjacent sides of two adjacent teeth, or on opposite sides of the tooth space through which the tools are passing. Referring to Figure 7, the tools c and d will cut on the sides c^1 and d^1, while tools e and f of the next pair cut the sides e^1 and f^1 of the teeth forming the next tooth space. In the last described arrangement of cutters, the distance between the cutting edges of each pair of tools preferably bears the same ratio to the distance between the last cutting edge of the pair and the initial cutting edge of the next pair of tools, as the width of the base of the tooth space at one edge bears to the distance from the base of one tooth space to the base of the next adjacent tooth space. Thus, referring to Figure 8, a^1 is in the same ratio to b^1 as a is to b. The relative rates of rotation of the blank and cutter are such that the blank moves through the space of one tooth while the cutter moves through the space of one tool, or one pair of tools, so that successive tools, or successive pairs of tools operate

on successive teeth. The curvature of the teeth lengthwise may be in either a right or left hand direction, or the amount of curvature may be equal and in opposite directions with reference to the center of the face of the gear. These different arrangements of curve do not constitute an essential part of the invention, but indicate the varying effects that can be had by changing the relative adjustments and speeds of the cutter and blank.

The gear produced by the method described herein is not confined to any particular system of generation, as the idea of a roulette curve may successfully be applied to any of the various known generating methods or machines, as well as to processes or machines producing involute teeth.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A gear having teeth curved from end to end on an arc of a roulette.
2. A gear having generated teeth curved from end to end on an arc of a roulette.
3. A gear having involute teeth curved from end to end on an arc of a roulette.
4. A gear having teeth formed by moving a tool through a blank in a curved path and simultaneously imparting a continuous rotary movement to the blank about its axis.
5. A gear having teeth formed by moving a tool through a blank in a circular path, imparting a continuous rotary movement to the blank about its axis during the cutting operation, and simultaneously producing a relative generating movement between the cutter and blank.
6. A gear having teeth formed by moving a tool through a blank in a circular path and simultaneously imparting a continuous rotary movement to the blank about its axis.
7. A gear having generated involute teeth curved from end to end on an arc of a roulette.

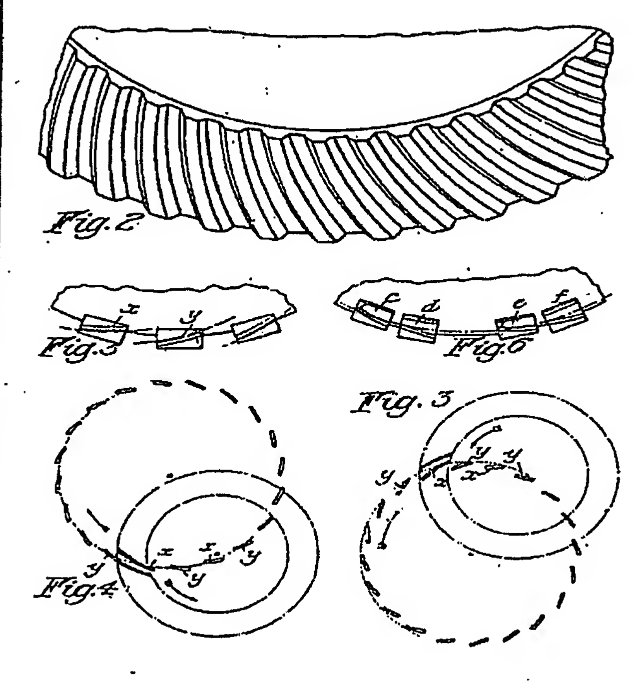
Dated this 25th day of April, 1917.

BOULT, WADE & TENNANT,
111 & 112, Hatton Garden, London, E.C.,
Chartered Patent Agents.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1917.

SHEET 1.

[This Drawing is a reproduction of the Original on a reduced scale.]



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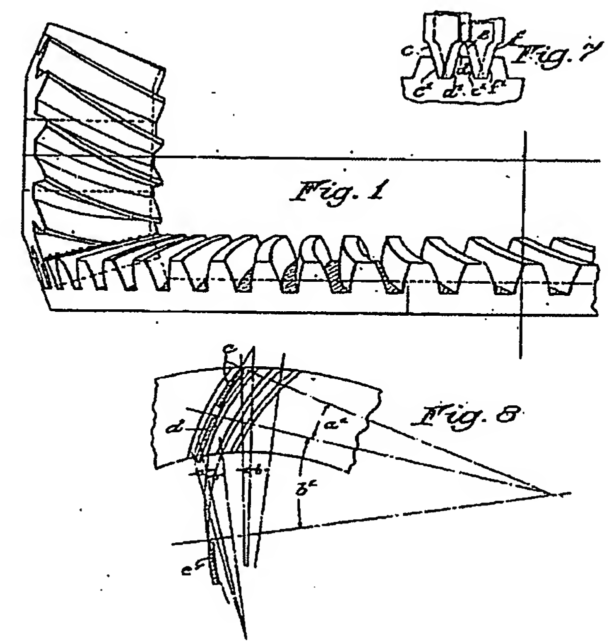

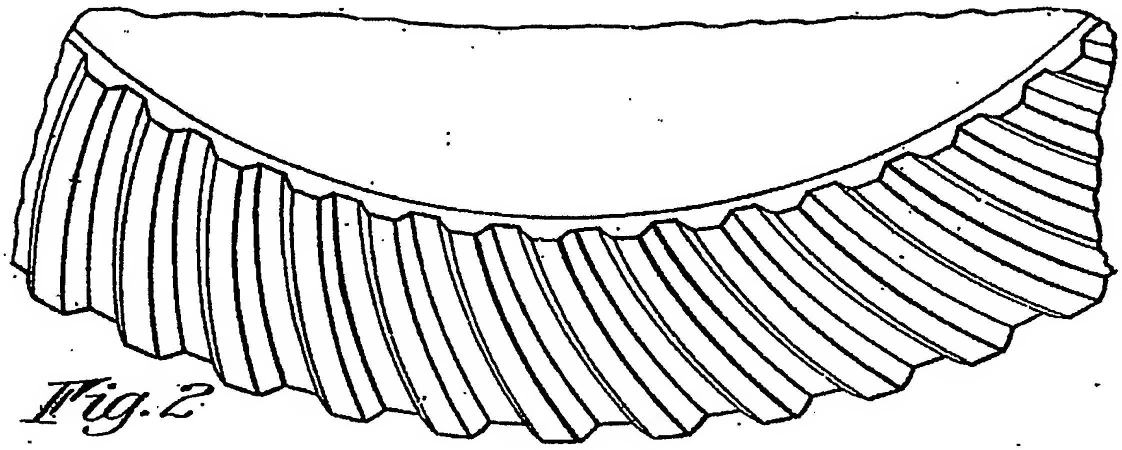

Fig. 2

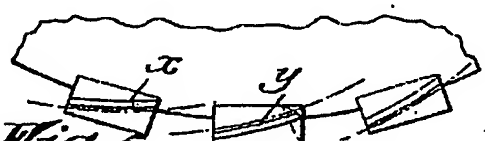

Fig. 5

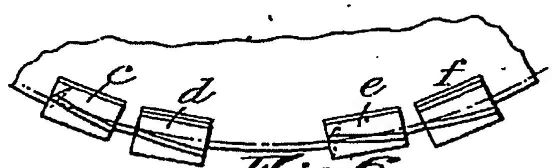

Fig. 6

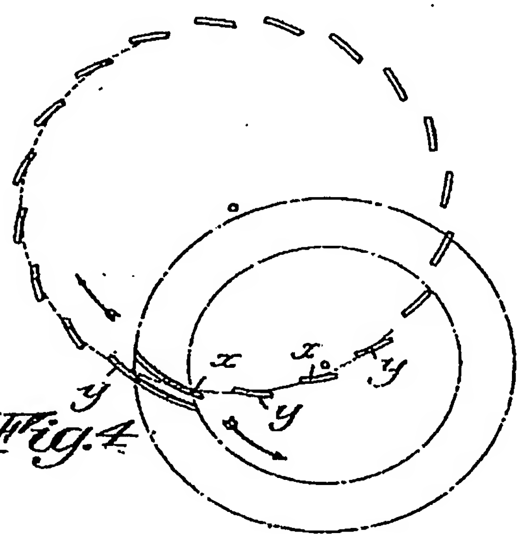

Fig. 4

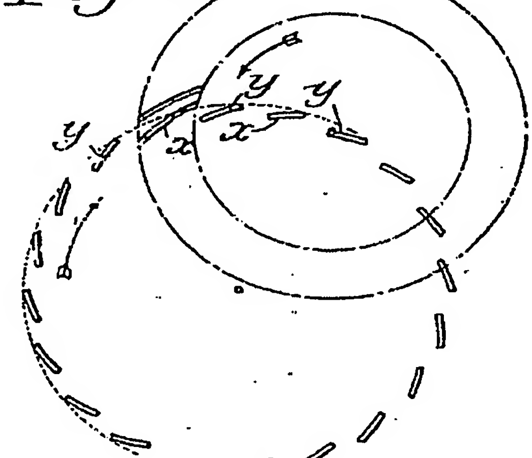

Fig. 3

[This Drawing is a reproduction of the Original on a reduced scale.]

(2 SHEETS)

SHEET 2.

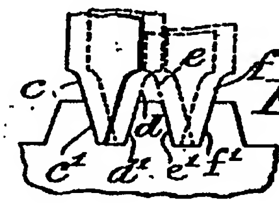

Fig. 7

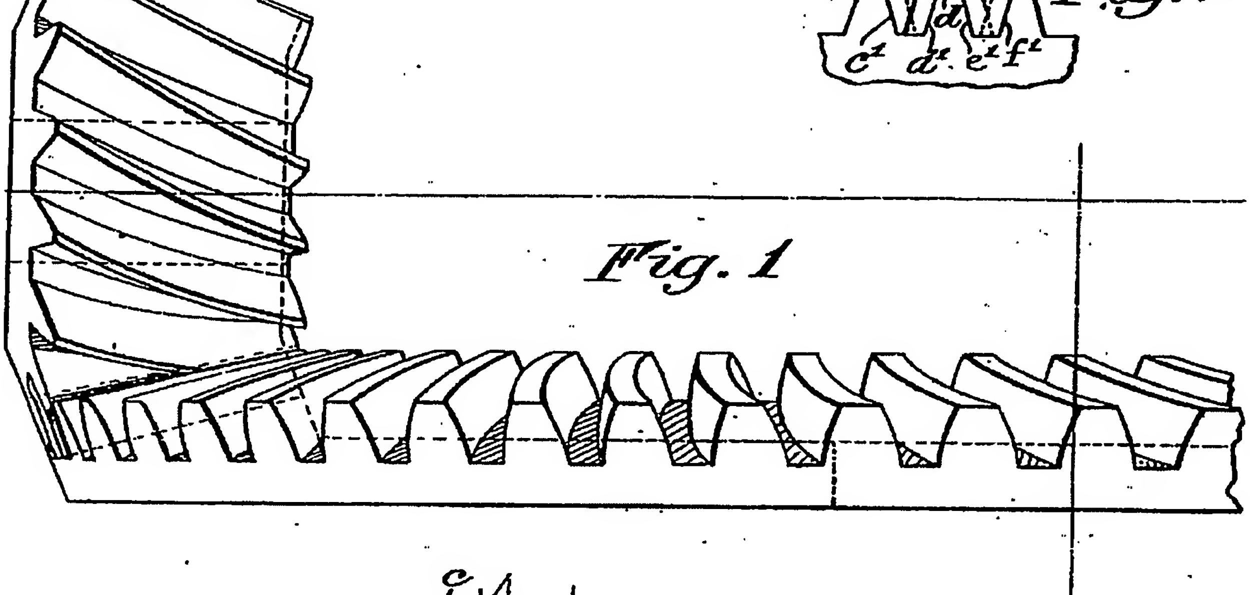

Fig. 1

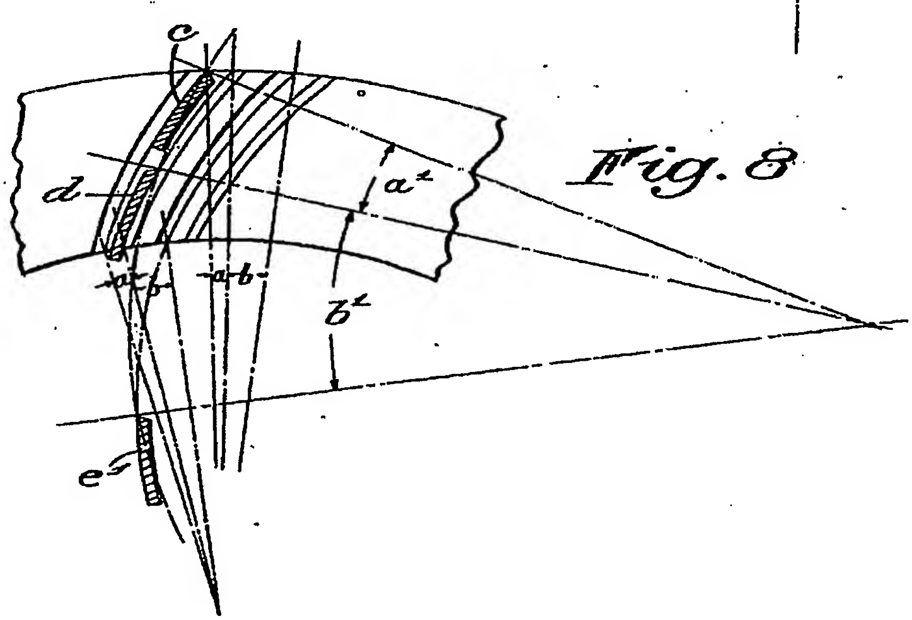

Fig. 8